

Control of *Brucella melitensis* infection in a large camel herd in Saudi Arabia using antibiotherapy and vaccination with Rev. 1 vaccine

A.I. RADWAN, S.I. BEKAIRI, A.A. MUKAYEL, A.M. AL-BOKMY,
P.V.S. PRASAD, F.N. AZAR and E.R. COLOYAN*

Summary: *The authors describe an attempt to control Brucella melitensis infection in a large camel herd in Saudi Arabia.*

Sera from the entire herd (2,536) were examined by the Rose Bengal and standard United States of America buffered plate agglutination tests. The overall Brucella seroprevalence was 8%. Milk samples from the 120 seropositive milking camels were cultured on Brucella-selective media. B. melitensis biovars 1, 2 and 3 were isolated from 41 camels (34%).

Seropositive camels (202) were treated for the first time with a combination of long-acting oxytetracycline (OTC) at a dose of 25 mg/kg administered intramuscularly (i.m.) every 2 days for 30 days and streptomycin at 25 mg/kg i.m. every 2 days for 16 days. In addition, milking camels were given OTC-intramammary infusion at a rate of 10 ml/teat every 2 days for 8 days. This regimen was found to be effective in eliminating the shedding of Brucella organisms by camels, with no relapse. Moreover, all treated camels became seronegative within 16 months after treatment.

Seronegative camels (2,331) were vaccinated for the first time with the B. melitensis Rev. 1 strain vaccine, as follows:

a) *175 young camels (aged three months to one year) were each inoculated subcutaneously with a full dose ($1-2 \times 10^9$ viable organisms in 1 ml). Brucella antibody titres between 1:50 and 1:200 were detected 2-4 weeks post-vaccination. Brucella antibodies decreased gradually until the animals became seronegative 8 months after vaccination.*

b) *2,156 camels aged more than one year were each inoculated subcutaneously with a reduced dose ($1-2 \times 10^6$ viable organisms in 1 ml). Antibody titres measured 2-4 weeks post-vaccination varied from 1:25 to 1:200. The titres decreased gradually, until the animals became seronegative 3 months post-vaccination.*

No Brucella organisms were recovered from repeated udder secretion samples from all vaccinated milking camels, and no abortions were recorded among pregnant vaccinated camels.

* Animal Production and Health Section, National Agriculture and Water Research Centre, Ministry of Agriculture and Water, P.O. Box 17285, Riyadh 11484, Saudi Arabia.

KEYWORDS: *Brucella melitensis* – Brucellosis – Camel diseases – *Camelus dromedarius* – Oxytetracycline – Rev. 1 strain vaccine – Saudi Arabia – Streptomycin – Therapy – Vaccination.

INTRODUCTION

Camels of both species (*Camelus dromedarius* and *C. bactrianus*) are frequently infected with *Brucella* organisms, especially when they are in contact with infected large and small ruminants (26, 32). Serological evidence for *Brucella* infection in camels has been reported from Asia and Africa (1, 5, 6, 11, 12, 17, 20, 21, 22, 23, 26, 28). In addition, abortions have been reported in pregnant camels and *B. abortus* has been isolated from aborted fetuses, genital discharges, urine and milk (32). Moreover, *Brucella melitensis* biovars 1 and 2 have been isolated recently from camel milk in Saudi Arabia (26). Human infection due to *Brucella* from camels is known to occur, mostly through the consumption of unheated milk (15, 16, 32). Control of brucellosis on camel farms has been limited to serological tests and slaughter of reactors (32).

In Saudi Arabia, the National Agriculture and Water Research Centre (NAWRC) in Riyadh received complaints, from a large camel farm, of abortions reaching 12% in one camel herd. Malta fever due to *B. melitensis* was also diagnosed in 30% of the camel handlers and milkers on this farm. Investigation by the NAWRC revealed the presence of a large flock of sheep and goats (3,600 head) on the same farm as the camel herd. The seroprevalence of brucellosis in this flock of small ruminants was 20%, and *B. melitensis* biovars 1, 2 and 3 were isolated from milk and from aborted sheep and goat fetuses. The flock of small ruminants was moved to a remote, isolated area and the infection in the herd was controlled (reported elsewhere). The cases of human brucellosis in the camel farm were diagnosed and treated by the local health authorities. Furthermore, *B. melitensis* biovars 1, 2 and 3 were isolated from aborted camel fetuses submitted to the NAWRC. As the camels involved were valuable animals with superior genes, there was an urgent need for effective measures to protect non-infected camels, and for an effective treatment regimen as an alternative to slaughter of infected camels.

The purpose of the present study was to control camel brucellosis in the infected herd by implementing a new treatment regimen which was found to be effective and successful in Saudi Arabia on sheep, goats and cattle infected with *B. melitensis* (24, 25, 27). The control procedure presented here involves three successive serological examinations (at three-month intervals), treatment of seropositive camels using oxytetracycline combined with streptomycin, and vaccination of all seronegative camels using *B. melitensis* Rev. 1 strain vaccine.

MATERIALS AND METHODS

Animals

The present study involved a herd of 2,536 head of camels (*C. dromedarius*) of valuable breeds, raised under an intensive management system for commercial milk production in Saudi Arabia. The herd consisted of 94 males and 2,442 females of local (1,349 Magaheam and 402 Magateer) and imported (785 Pakistani) breeds. The age of the camels ranged between three months and ten years. The body weight ranged from

150 kg to 750 kg. The herd contained 966 lactating camels (the stages of lactation were not known) and approximately 500 pregnant camels (stages of pregnancy not recorded).

Serological testing

All camels in the herd were subjected to three successive serological examinations (performed at three-month intervals). The serum samples were inactivated by heating to 60°C for 30 min (as unheated camel sera gave inconsistent results on repeated examination with Rose Bengal antigen) and initially screened for the presence of *Brucella* agglutinins, using the Rose Bengal test (4). The Rose Bengal test antigen was obtained from the Central Veterinary Laboratory, Weybridge, United Kingdom. Sera yielding positive reactions in the Rose Bengal test were further tested by the standard United States of America (USA) buffered plate agglutination procedure, for determination of *Brucella* antibody titres (4). The standard *Brucella* plate antigen (made from *B. abortus* strain 1119-3) was obtained from the United States Department of Agriculture in Ames, Iowa. Agglutination at 1:100 or higher was considered positive (22, 26). Animals yielding positive results were removed from the herd after each test.

Following vaccination of the seronegative camels and treatment of the seropositive camels, the antibody titres were monitored in both groups for two years (the study period). Parallel serum samples from a seropositive non-treated control camel were also included. In addition, sera from all calves born to both vaccinated and treated camels were examined immediately after birth.

Therapeutic agents

The antibiotics used in this study were as follows:

- Long-acting oxytetracycline (LA-OTC) injectable solution (from France) containing 200 mg/ml OTC base.
- Streptomycin sulphate (ST) (from Egypt) supplied in vials, each containing 1 g or 4 g, which were reconstituted in sterile distilled water (3 ml or 12 ml, respectively) just prior to use.
- OTC intramammary infusion (IMI) (from the Netherlands) in 10 ml syringes, each containing 200 mg tetracycline hydrochloride, 250 mg neomycin base, 2,000 international units bacitracin, 10 mg prednisolone and excipient to 8 g.

Treatment regimen

Of the 205 camels giving positive results in *Brucella* antibody tests, 202 animals (120 milking camels, 52 non-milking, 16 adult males and 14 female calves) were each treated with a combination of LA-OTC 25 mg/kg i.m. every two days for thirty days and ST 25 mg/kg i.m. every two days for sixteen days. In addition, the milking camels were also given OTC-IMI 10 ml/teat every two days for eight days after stripping the udder and cleansing the teats. Both ST and OTC-IMI were administered with LA-OTC at the commencement of therapy. The LA-OTC and ST were injected i.m. in the cervical, thigh and shoulder muscles at a dose of 20-30 ml per site. The camel body weight was estimated using the following formula (30):

$$(\text{chest girth in cm} \times 5.071) - 457 = \text{weight in kg.}$$

The treatment was implemented without regard to age, stage of lactation, number of previous pregnancies, date of most recent pregnancy or number of previous abortions due to *Brucella*. The date of previous abortions in relation to the date of initiation of treatment was not recorded on the farm. In addition to the 202 treated camels, one

seropositive milking camel (non-*Brucella* shedder) was isolated from the herd and monitored for *Brucella* antibody titres over two years, and two camels were used as controls for bacteriological examination (see below).

Vaccine and vaccination

All 2,331 seronegative camels were vaccinated with the Elberg smooth living virulent *B. melitensis* Rev. 1 strain vaccine (8), as follows:

a) 175 young male and female camels (aged from three months to one year) were each inoculated subcutaneously with a full dose, containing $1-2 \times 10^9$ viable organisms in 1 ml

b) 2,156 camels aged more than one year (males and females [pregnant, non-pregnant, lactating and non-lactating]) were each vaccinated with a smaller dose, containing $1-2 \times 10^6$ viable organisms in 1 ml.

Bacteriological examinations

Farrell's modified medium was used for *Brucella* culture and prepared as described previously (9, 25). Immediately prior to initiation of the therapeutic regimen, fresh milk samples (30 ml taken separately from each quarter) were collected aseptically from all 120 milking camels with *Brucella* antibodies. Each milk sample was streaked (with a sterile cotton swab) onto four plates of the selective medium, for determination of *Brucella* shedder camels. Similar samples from the same seropositive camels were also cultured each week throughout treatment and, subsequently, each month from completion of treatment to the end of the study (two years). After calving, repeated udder secretion samples were also taken, at monthly intervals, from the remaining treated camels (which were not lactating at the time of initiation of treatment); these samples were cultured using the same procedure. In addition, bi-weekly milk samples from all 844 seronegative milking camels were cultured for a four-month period following vaccination with the reduced dose of Rev. 1 vaccine.

Two *Brucella* shedder camels were kept as controls and used for bacteriological examination. One camel was sacrificed immediately prior to initiation of the treatment regimen, and the second was sacrificed four months after the initiation of treatment. The following samples from the two control camels were collected aseptically: udder secretions and/or udder tissues; supramammary, prescapular, iliac, precrucial, mediastinal, mesenteric and head lymph nodes; sections of brain, uterus, ovary, liver and spleen; bone marrow from the long bones of the front and hind limbs. Each tissue specimen was separately homogenised in a tissue grinder, and aliquots were spread with sterile cotton swabs onto four freshly-prepared plates of culture medium. The plates were incubated at 37°C for seven days in the presence and absence of 5% CO₂ atmosphere. The isolated *Brucella* cultures were identified morphologically, microscopically, biochemically and serologically (4). The biotyping of the identified isolates was performed at the Central Veterinary Laboratory, Weybridge, United Kingdom.

RESULTS

Serological findings

A total of 205 camels were found to have *Brucella* antibodies in serum by the three successive serological examinations (at three-month intervals): 155, 42 and 8 camels in the first, second and third tests, respectively (Table I). The overall *Brucella* antibody

TABLE I

Incidence of brucellosis in a large camel herd in Saudi Arabia

Serological examination *	No. of camels tested **			No. (%) of camels yielding positive results		
	Total	Males	Females	Total	Males	Females
1	2,536	94	2,442	155 (6)	12	143
2	2,381	82	2,299	42 (1.8)	3	39
3	2,339	79	2,260	8 (0.3)	1	7
Total				205 (8)	16 (17)	189 (8)

*three successive examinations at three-month intervals

** seropositive camels were removed from the herd after each examination

prevalence was 8% (205 of 2,536). Of the seropositive camels, 189 were females (122 milking, 53 non-milking and 14 young female camels) and 16 males of various age groups (three months to ten years). The *Brucella* antibody titres in the positive camels are shown in Table II. The brucellosis seroprevalence was 12% (94 of 785) among imported camels and 6% (111 of 1,751) among local camels. The seroprevalence was 17% (16 of 94) in males and 8% (189 of 2,442) in females.

After treatment of the seropositive camels was completed, a gradual, slow decrease in antibody titres was observed, and all treated camels became seronegative within sixteen months of the completion of treatment. The untreated control camel, however, remained seropositive over the same period. In addition, all calves born to treated or vaccinated camels were serologically negative for brucellosis.

The seronegative camels included 175 animals aged between three months and one year, and 2,156 aged more than one year. All young camels (175 head) vaccinated with the full dose of Rev. 1 vaccine produced maximum antibody titres (ranging between 1:50 and 1:200) at two to four weeks post-vaccination. The titres then decreased slowly until they completely disappeared eight months post-vaccination (Fig. 1). When the 2,156 camels aged more than one year were vaccinated with the reduced dose of Rev. 1

TABLE II

Brucella antibody titres (measured by the standard United States of America buffered plate agglutination test) of 205 seropositive camels from a large herd in Saudi Arabia prior to treatment and vaccination

No. of camels	Antibody titres				
	1:25	1:50	1:100	1:200	1:400
87	+	+	+		
78	+	+	+	+	
40	+	+	+	+	+

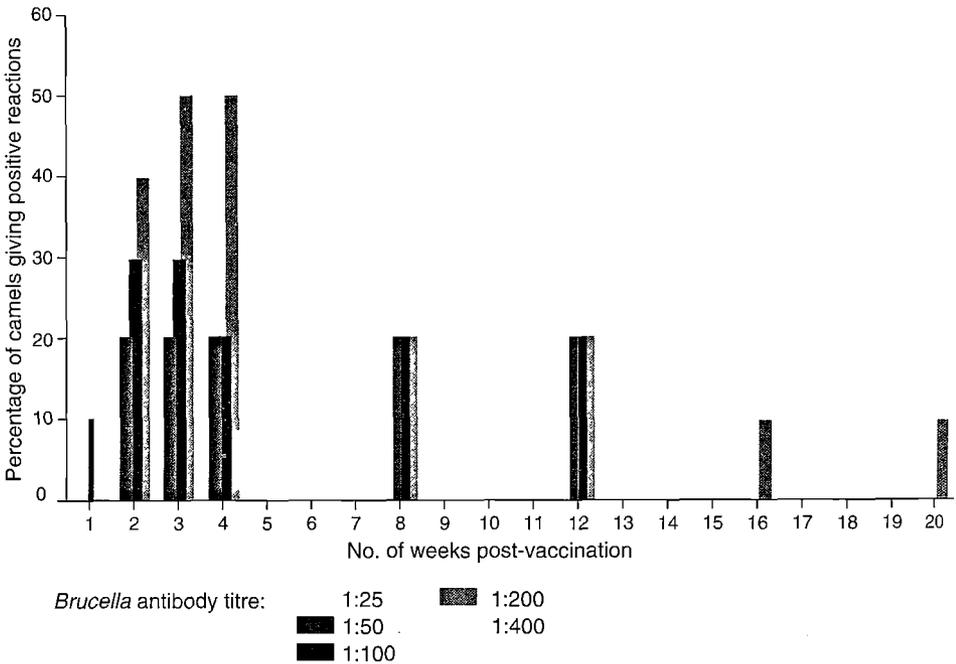


FIG. 1

Serological response (measured by standard United States of America buffered plate agglutination test) of young camels following vaccination with a full dose of Rev. 1 vaccine ($1-2 \times 10^9$ viable organisms)

vaccine, however, the majority of camels produced titres between 1:25 and 1:200 at two to four weeks post-vaccination, which then decreased gradually until they disappeared three months post-vaccination (Fig. 2).

Bacteriological findings

In the investigation performed just prior to the present study, *B. melitensis* biovars 1, 2 and 3 were isolated from aborted camel fetuses submitted to the NAWRC. When milk samples from the 120 seropositive milking camels were cultured just before treatment, *B. melitensis* biovars 1, 2 and 3 were also isolated from 41 camels (34%). Two weeks after the commencement of treatment, however, shedding of *Brucella* organisms in milk ceased and did not recur during the study period. Moreover, the repeated udder secretion samples taken from the remaining treated seropositive camels after calving were found to be *Brucella*-free upon culture.

When a seropositive control camel was sacrificed before treatment, *B. melitensis* biovar 2 was isolated (more than 200 colonies per plate) from the mammary secretions, mammary tissues and supramammary lymph nodes. All other selected tissue specimens from the same camel were found to be free from *Brucella*. In contrast, the selected tissue specimens from the other seropositive control camel (sacrificed four months post-treatment) were all found to be free from *Brucella* organisms. Unfortunately, the authors were unable to persuade the owner of the camel herd to sacrifice a group of

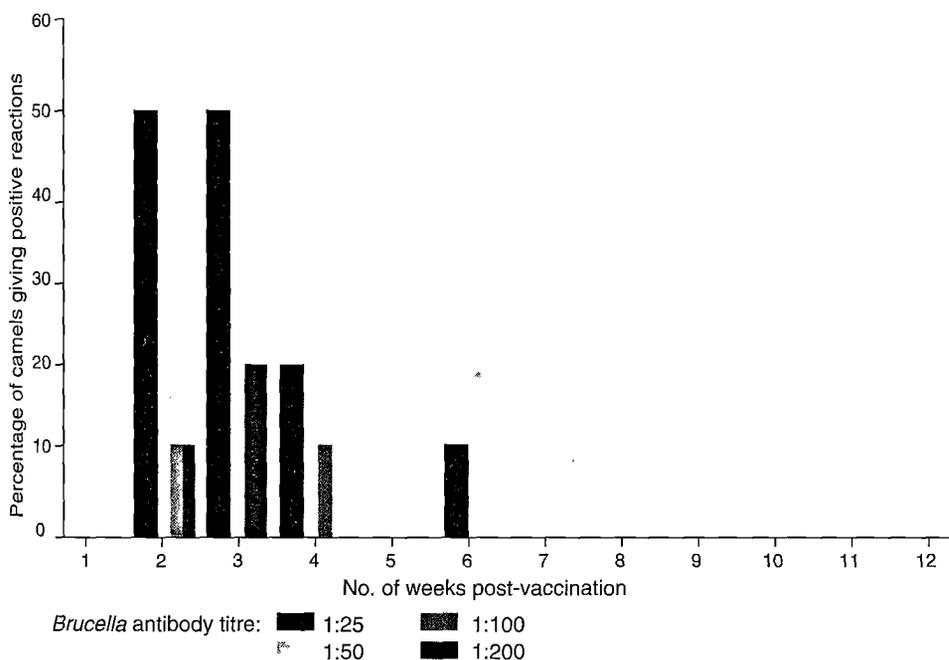


FIG. 2

Serological response (measured by standard United States of America buffered plate agglutination test) of adult camels following vaccination with a reduced dose of Rev. 1 vaccine ($1-2 \times 10^6$ viable organisms)

seronegative camels for bacteriological examination before vaccination, to detect the possible presence of seronegative camels which were infected.

No *Brucella* organisms were recovered from any of the repeated udder secretion samples collected from all vaccinated milking camels (for four months post-vaccination), and no abortions were recorded among the pregnant vaccinated or treated camels.

Cost of therapeutic agents and camels

The cost of antibiotics used was calculated in accordance with prices on the Saudi market at the time of conducting the study (US\$1= SR3.75). The weight of the treated camels ranged between 150 kg and 750 kg. The average cost of the therapeutic agents alone used in treating a lactating camel weighing 600 kg was US\$175 (SR656), while for a non-lactating female or a male camel of similar weight the cost was approximately US\$150 (SR560). This did not include the cost of other services, as all laboratory examinations were provided free of charge by government staff and the farm involved has its own veterinary staff and supplies. Under other circumstances, the cost of interventions has to be considered.

The following are average prices of camels on the Saudi market at the time of the study:

- adult male of special breed: SR250,000-SR1,000,000
- adult milking camel for breeding purposes: SR30,000-SR40,000
- adult milking camel of ordinary breed: SR3,000-SR4,000

- one-year-old male of special breed: SR4,000-SR10,000
- one-year-old male destined for slaughter: SR1,500-SR2,500.

The treatment regimen used in this study did not have any harmful local or systemic side-effects on the health of the treated camels. In addition, meat inspection of a treated control camel (slaughtered four months post-treatment) did not reveal any detectable abnormalities in the muscles at the site of repeated i.m. inoculation.

DISCUSSION

Prevention of brucellosis in humans ultimately depends on control of the disease in the animal hosts. Efforts to control brucellosis are justified economically and in terms of public health. The economic aspects include losses due to clinical disease (in humans and animals), and other losses associated with agricultural markets for animals and animal products. The recommended forms of control are 'test and slaughter' and 'vaccination' (19, 32). The test and slaughter method is recommended when the disease is confirmed serologically and bacteriologically. In such cases, the entire herd should be regarded as infected; alternatively, all animals should be tested and seropositive animals slaughtered. Mass vaccination of infected herds protects only uninfected animals, without altering the course of disease in those already infected. The infected vaccinated animals thus remain a great hazard to public health. In addition, the 'test and slaughter' method, combined with calfhood vaccination, no doubt results in a considerable reduction in the number of infected herds. This strategy is outside the economic scope of developing countries, however, especially when expensive animals with high genetic potential are involved: camel producers in Saudi Arabia and other developing countries cannot afford the traditional test and slaughter approach used in developed countries.

Although previous treatment trials on *Brucella*-infected cows were not fully successful (18), the treatment regimens which have recently been developed, evaluated and implemented on *Brucella*-infected sheep, goats and cows in Saudi Arabia have proved to be practical, effective, economical and safe (24, 25, 27). The successful treatment regimens were based on using a combination of LA-OTC and ST.

In view of the prolonged incubation period in some *Brucella*-infected animals and the possible occurrence of latent *Brucella* infection, the present study involved three successive serological testings (i.e. a single negative serological test may not be relied upon for diagnosis in an individual animal). Consequently, camels were considered brucellosis-free only after passing three successive negative tests. In addition, because of the limited reliability of a single serological test in detecting individual infected animals, a combination of two tests was used. The Rose Bengal test has found wide application in screening but, as this test is generally considered to be oversensitive, positive sera are usually re-tested by another method (32). The Rose Bengal test reacts mostly with IgG antibodies, which are produced in active and chronic stages of infection. Both the Rose Bengal test and the standard USA buffered plate agglutination procedure were adopted in this study and others (24, 25, 26, 27) due to their sensitivity, simplicity and applicability in the field. Titres of 1:100 or higher were taken as diagnostic evidence for camel brucellosis (22, 26). There was full correlation between all sera showing titres of 1:100 or higher in the USA standard buffered plate agglutination test and positive reactions in the Rose Bengal test.

By these criteria, the overall brucellosis seroprevalence in the tested camel herd was 8% (205 of 2,536). This prevalence was similar to that previously reported in a camel herd in central Saudi Arabia (26). The prevalence among the imported camels (12%) was twice as high as in local camels (6%). Although the imported camels came from a country where *Brucella* infection is known to exist, they were not tested on arrival in Saudi Arabia; consequently, it is not known whether the animals contracted the infection abroad or locally. In addition, brucellosis seroprevalence was much higher in male camels (17%) than in female camels (8%): no explanation has been found for this result. In previous studies in Saudi Arabia and Sudan, male and female camels showed no significant difference in brucellosis seroprevalence (1, 26).

In countries such as Saudi Arabia, where *B. melitensis* infection is widespread among sheep and goats, vaccination of livestock with the Elberg *B. melitensis* Rev. 1 strain vaccine is considered to be superior to the use of other live or inactivated vaccines. There is good evidence that this vaccine produces strong immunity against brucellosis in sheep, goats and cattle (7, 8, 10, 13, 14, 31). Moreover, experiments have shown that Rev. 1 vaccine is capable of producing immunity in lactating or pregnant adult goats when administered in doses much smaller than those originally used. These lower doses produce neither abortion nor excretion of the vaccine strain, and provoke a greatly reduced serological response (2). In addition, the reduced dose of Rev. 1 vaccine gave protection in adult animals comparable to that produced by a full dose of the vaccine (2). Furthermore, Rev. 1 vaccine has been recommended for use in cattle, particularly in areas where *B. melitensis* is prevalent in small ruminants (32). Animals vaccinated against brucellosis develop both humoral and cell-mediated immune responses. Cell-mediated immunity is considered the major immune defence mechanism against intracellular infections caused by *Brucella* (29, 31). Humoral antibodies do not correlate well with protective immunity, as vaccinated animals showed long-lasting protection while antibody titres fell below detectable levels within a few months after vaccination. Furthermore, there is no evidence of increased virulence following successive passage of Rev. 1 in animals, and there have been no reports of infection spreading from animals vaccinated with Rev. 1 to non-vaccinated animals. However, Rev. 1 is pathogenic for humans if accidentally injected (8).

Vaccination of uninfected animals is generally considered the most effective and economical means of protecting livestock against brucellosis. Consequently, vaccination was performed on all negative reactors immediately after the third serological testing, to avoid the possible presence of carrier animals. Vaccination of seronegative young camels with a full dose of Rev. 1 caused the development of the highest level of antibodies two to four weeks post-vaccination. This high antibody level continued in some camels for two months, then decreased gradually and totally disappeared eight months post-vaccination. Vaccination of seronegative camels aged more than one year, with the reduced dose of Rev. 1, produced antibody titres two to four weeks post-vaccination. These titres disappeared three months post-vaccination. Vaccination of pregnant camels with the reduced dose of Rev. 1 did not cause any abortion, and the vaccine strain was not excreted in the milk of vaccinated milking camels. Similar results have been obtained in cows vaccinated with a reduced dose of Rev. 1 vaccine, and the vaccinated cattle became seronegative eight to ten months post-vaccination (10, 13). In addition, the serological response of adult goats to a reduced dose of Rev. 1 (1.2×10^6) reached a maximum level two to three weeks post-vaccination, and the titres disappeared within 105 days post-vaccination (3, 7). Unfortunately, challenge tests could not be made in the present study to determine the duration of protection in camels due to Rev. 1 vaccination. Furthermore, it was not possible to keep unvaccinated

control camels in the herd, as the owner was deeply concerned about immediate protection of both the camels and the camel caretakers against further infection with *Brucella*. The absence of such unvaccinated control groups (for full and reduced doses) prevented precise evaluation of the results obtained by vaccination or treatment. Nevertheless, after considerable effort, the authors were able to obtain three seropositive control camels: one *Brucella* non-shedder camel (used to monitor antibody titre for two years) and two *Brucella*-shedder camels for bacteriological examination (one sacrificed prior to treatment, and the other sacrificed four months after treatment).

The selective medium used for evaluation of the treatment regimen in this study was reported to give a higher isolation rate of *Brucella* organisms from fresh milk and tissues than any of the other currently-known selective media, and is equivalent to guinea-pig inoculation (9). The overall prevalence of shedders of *Brucella* organisms in milk among the 120 seropositive milking camels was 34%. This prevalence was much higher than that previously observed in another camel herd (26). *Brucella* organisms are known to be shed intermittently in the milk of infected cows, but the duration of *Brucella* shedding in infected camels is not known. The present treatment regimen was found to be practical, safe, effective and successful in complete elimination of *B. melitensis* from the mammary secretions of shedder camels. Furthermore, relapse did not occur in any of the treated camels during the two-year study period. In addition, the selected tissue specimens from the treated control camel were all found to be *Brucella*-free, while *B. melitensis* biovar 2 was isolated from milk, udder tissue and supramammary lymph nodes of the untreated control camel. Moreover, all treated camels became seronegative sixteen months post-treatment, while the untreated control camel remained seropositive. The relatively low cost of antibiotics used for treatment of camels in this study makes implementation of this regimen economically feasible in Saudi Arabia. Under the treatment regimen described, no harmful effects were expected in humans due to antibiotic residues in the milk, as the milk was discarded during the period of treatment and for one month post-treatment.

CONCLUSION

The control procedure described above for *B. melitensis* infection in camels involved three successive rounds of serological testing, treatment of seropositive camels using a combination of LA-OTC and ST, and vaccination of all seronegative camels with *Brucella* Rev. 1 strain vaccine. This procedure seemed to be effective, practical, safe, successful and economically acceptable: it is particularly recommended for valuable breeds of camels as an alternative to slaughter of infected camels with superior genes.

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PROPHYLAXIE DE L'INFECTION PAR BRUCELLA MELITENSIS DANS UN GRAND TROUPEAU DE DROMADAIRES EN ARABIE SAOUDITE, AVEC ANTIBIOTHÉRAPIE ET ADMINISTRATION DE VACCIN REV. 1. – A.I. Radwan, S.I. Bekairi, A.A. Mukayel, A.M. Al-Bokmy, P.V.S. Prasad, F.N. Azar et E.R. Coloyan.

Résumé : Les auteurs décrivent un essai de prévention de l'infection par *Brucella melitensis* dans un grand troupeau de dromadaires en Arabie saoudite.

Les sérums de l'ensemble du troupeau (2 536 animaux) ont été analysés par deux méthodes de diagnostic : l'épreuve du « rose bengale » (RB) et l'épreuve standard d'agglutination sur plaques tamponnées utilisée aux Etats-Unis d'Amérique. La séroprévalence totale vis-à-vis de *Brucella* était de 8 %. Des prélèvements de lait, effectués sur 120 femelles allaitantes possédant des anticorps, ont été mis en culture en milieu sélectif pour le genre *Brucella*. Les biovars *B. melitensis* 1, 2 et 3 ont été isolés chez 41 dromadaires (34 %).

Les dromadaires possédant des anticorps (202), ont été traités par voie intramusculaire et, pour la première fois en association avec une dose d'oxytétracycline longue durée (OTC) de 25 mg/kg, tous les deux jours pendant trente jours et une dose de streptomycine de 25 mg/kg tous les deux jours pendant seize jours. De plus, les femelles allaitantes ont reçu une injection intramammaire d'OTC à raison de 10 ml/trayon, un jour sur deux pendant huit jours. Ce traitement s'est révélé très efficace : les excrétions de *Brucella* par les dromadaires ont cessé et aucune récurrence n'a été observée. En outre, les anticorps ont disparu chez tous les dromadaires dans les 16 mois qui ont suivi le traitement.

Les dromadaires sans anticorps (2 331) ont été immunisés pour la première fois à l'aide d'un vaccin produit à partir de la souche Rev. 1 de *B. melitensis*, de la manière suivante :

a) 175 jeunes dromadaires (âgés de trois mois à un an) ont reçu, chacun et par voie sous-cutanée, une dose complète ($1-2 \times 10^9$ d'organismes viables pour 1 ml). Les titres d'anticorps de *Brucella* étaient de 1:50 à 1:200 au cours des deux à quatre semaines après la vaccination. Les anticorps de *Brucella* ont ensuite diminué progressivement jusqu'à ce que les animaux perdent leurs anticorps huit mois après la vaccination.

b) 2 156 dromadaires de plus d'un an ont reçu, chacun et par voie sous-cutanée, une dose réduite ($1-2 \times 10^6$ d'organismes viables pour 1 ml). Les titres d'anticorps mesurés dans les deux à quatre semaines suivant la vaccination variaient de 1:25 à 1:200, pour diminuer ensuite progressivement jusqu'à disparaître trois mois après la vaccination.

Après vaccination, aucune *Brucella* n'a été mise en évidence dans les nombreux prélèvements de sécrétion mammaire effectués sur toutes les femelles allaitantes et aucun avortement n'a été signalé chez les femelles gestantes.

MOTS-CLÉS : Arabie saoudite – *Brucella melitensis* – Brucellose – *Camelus dromedarius* – Maladies des camélidés – Oxytétracycline – Streptomycine – Thérapie – Vaccin de souche Rev. 1 – Vaccination.

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CONTROL DE LA INFECCIÓN POR *BRUCELLA MELITENSIS* EN UN GRAN REBAÑO DE DROMEDARIOS MEDIANTE ANTIBIOTERAPIA Y VACUNACIÓN CON LA VACUNA REV. 1 EN ARABIA SAUDÍ. – A.I. Radwan, S.I. Bekairi, A.A. Mukayel, A.M. Al-Bokmy, P.V.S. Prasad, F.N. Azar y E.R. Coloyan.

Resumen: Los autores describen una iniciativa experimental para controlar la infección por *Brucella melitensis* de un gran rebaño de dromedarios en Arabia Saudí.

Para empezar, se aplicaron al suero extraído de todos los animales del rebaño (2.536 individuos) la prueba de aglutinación tamponada sobre placa (estándar estadounidense) y la prueba de rosa de bengala. La prevalencia sérica de *Brucella* que tales pruebas indicaron fue, en total, del 8%. Se cultivaron, en un medio selectivo para *Brucella*, muestras de leche de las 120 hembras lactantes seropositivas. De aquellas muestras, 41 (un 34%) depararon el aislamiento de los biovares 1, 2 y 3 de *B. melitensis*.

Por primera vez se trató a los dromedarios seropositivos (202 individuos) con una combinación de oxitetraciclina (OTC) de acción prolongada y de estreptomycinina. La primera se aplicó, por vía intramuscular (i.m.), a una dosis de 25 mg/kg cada 2 días durante 30 días; en cuanto a la estreptomycinina, se administraron 25 mg/kg i.m. cada 2 días durante 16 días. Además de ello, se administró OTC por infusión intramamaria a las hembras lactantes, a razón de 10 ml/tetilla cada 2 días durante 8 días. Se descubrió que este tratamiento resultaba eficaz para eliminar la excreción de organismos *Brucella* en los dromedarios, sin que se produjeran además recaídas. Por otra parte, en el curso de los 16 meses siguientes al tratamiento todos los dromedarios tratados se convirtieron en seronegativos.

Los dromedarios seronegativos (2.331) fueron vacunados por vez primera con la vacuna anti-*Brucella melitensis* de cepa Rev. 1. Esta vacunación se llevó a cabo de la manera siguiente:

a) Se inoculó por vía subcutánea, a cada uno de los 175 dromedarios jóvenes (entre tres meses y un año de edad), una dosis completa ($1-2 \times 10^9$ organismos viables en 1 ml). De 2 a 4 semanas después de la vacunación, el título de los anticuerpos contra *Brucella* oscilaba entre 1:50 y 1:200. Esta medida fue gradualmente decreciendo hasta que, transcurridos 8 meses desde la vacunación, los animales habían pasado a ser seronegativos.

b) A los 2.156 dromedarios de más de un año de edad se les inoculó por vía subcutánea una dosis reducida ($1-2 \times 10^6$ organismos viables en 1 ml). Entre las 2 y las 4 semanas posteriores a la vacunación, el título de los anticuerpos variaba entre 1:25 y 1:200. Dicho valor experimentó un progresivo descenso hasta que, tres meses después de la vacunación, los animales eran ya seronegativos.

En las repetidas muestras de secreción mamaria que se tomaron de todas las hembras lactantes vacunadas no se detectó ningún organismo de *Brucella*, y tampoco se registró ningún aborto entre las hembras preñadas vacunadas.

PALABRAS CLAVE: Arabia Saudí – *Brucella melitensis* – Brucelosis – *Camelus dromedarius* – Enfermedades de los camélidos – Estreptomycinina – Oxitetraciclina – Terapia – Vacuna Rev. 1 – Vacunación.

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